

## LESSON 4: CONTOURS AND LANDFORMS

### PURPOSE

The next step to improving your map reading skills is to understand elevation and relief. This understanding includes your ability to recognize the different types of land formations.

This lesson introduces these two basic elements of map reading. First, it explains the concepts of contour lines and intervals. Mapmakers use them to show elevation and relief on a map as they would appear on the ground. Second, it explains and illustrates the 10 types of natural and man-made terrain features along with their corresponding contour lines.



<i>concave</i>	<i>mean sea</i>
<i>concentric</i>	<i>level</i>
<i>convex</i>	<i>ridge</i>
<i>cut</i>	<i>ridgeline</i>
<i>depression</i>	<i>saddle</i>
<i>draw</i>	<i>sinkhole</i>
<i>fill</i>	<i>spur</i>
<i>hachures</i>	

### INTRODUCTION

Earlier in this chapter, we mentioned that orienting a map requires the identification of at least two known points. Recall the story of Barry who became lost while on a bike rally. What would he have done if the bridge, river, and park entrance were not there? He would have had to rely on his knowledge of elevation, relief, and terrain features to orient his map and

determine his location. Competently using your map reading skills is extremely important in accomplishing your mission, regardless if you are on a land navigation exercise, a trip, a bike rally, etc.

### METHODS OF SHOWING RELIEF

Knowing what the terrain looks like along your route before you start a trip may save you time and trouble in reaching your destination. Elevation is the height, or vertical distance, of a point on the earth's surface above or below **mean sea level**. Maps show elevation in feet, meters, or yards. Relief is the shape of landforms on the earth's surface.

Mapmakers use five methods to show elevation and relief on a map: layer tinting, form lines, shaded relief, **hachures**, and contour lines. We will define all of these methods, but we will use only the contour lines in the remainder of your *Map Reading* instruction.

- Layer tinting shows relief by color. Mapmakers use a different color for each band of elevation. Each band represents a separate elevation range. Each range is defined in the legend. However, this method does not allow you to determine the exact elevation of a specific point — only its range.
- Form lines do not have a standard elevation and they give only a general idea of relief. Mapmakers show form lines as dashed lines on a map without elevation numbers.
- Shaded relief shows relief by a shadow effect on one side of terrain features. Mapmakers achieve the shadow effect by using tones and colors to darken one side of features (such as hills or ridges). The darker the shading, the steeper the slope. This

method is sometimes used with contour lines to emphasize those features.

- Hachures show relief using short broken lines. Mapmakers use them to show large, rocky outcrop areas and, on small-scale maps, to show mountain ranges, plateaus, and mountain peaks. As in the above methods, however, they do not represent exact elevations.
- Contour lines show relief and elevation on a standard topographic map. A contour line represents an imaginary line on the ground, above or below sea level. All points on a contour line are at the same elevation. Contour lines never cross one another. Standard colors for contour lines are brown, red, or black. The following are three types of contour lines:

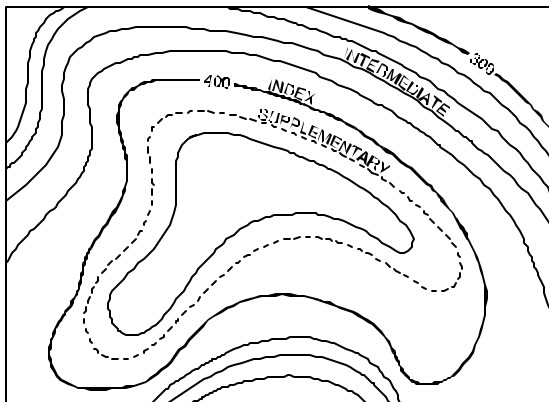


Illustration 2.4.1

1. *Index.* Starting at zero elevation, or mean sea level, every fifth contour line is always an index contour line, regardless of the contour interval. Mapmakers show index contour lines as a heavily drawn line with its elevation given somewhere along it, except where the contour interval is too small to print the elevation.
2. *Intermediate.* The contour lines that fall between the index lines are the intermediate contour lines. These lines are more finely drawn and they do not show the elevation

number. On U.S. maps, there will always be four intermediate contour lines between indexed lines.

3. *Supplementary.* These contour lines resemble dashes. They show sudden changes in elevation of at least one-half the contour interval for that map. If the map uses supplementary contour lines, do not count them as regular contour lines.

## CONTOUR INTERVALS

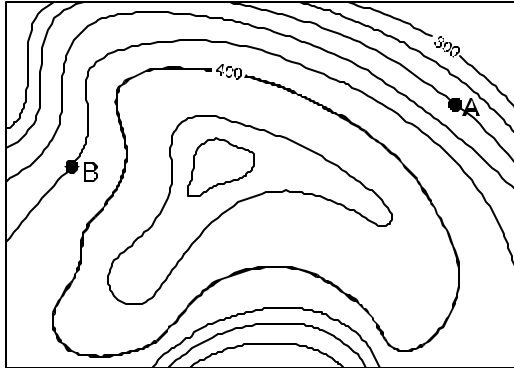
Printed below the bar scales in the middle of each map is the contour interval. This interval is the difference in height, or elevation, between one contour line and the one next to it.

You can estimate or determine the elevation of a point on a map by following the steps indicated below.

1. Determine the contour interval and the unit of measurement (feet, meters, or yards) from the marginal information.
2. Find the numbered index contour line nearest your point.
3. Count the number of intermediate contour lines to your point. If you are increasing elevation, add the contour interval to the nearest index contour line. If you are decreasing elevation, subtract the contour interval from the nearest index contour line.

For example, the point you want to locate is on the second intermediate contour line above the 300 meter index contour line (see Point A on Illustration 2.4.2). Note, the contour interval for this example is 20 meters. Since your point is closer to the 300 meter index contour line, start there and for each one of the intermediate contour lines that you cross or arrive at to reach your point, add 20 meters to the value of the

300-meter index line. Thus, the elevation of Point A is 340 meters. Notice that your elevation has increased.



*Illustration 2.4.2*

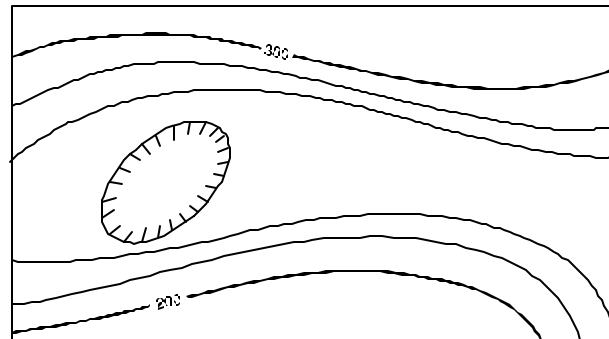
However, let's say that your point (Point B) is now located on the intermediate contour line immediately below the 400 meter index contour line. Below means downhill, or at a lower elevation. Therefore, for the one intermediate contour line that you arrive at to reach this point, subtract 20 meters from the value of the 400 meter index line. The elevation of Point B is 380 meters.

To determine the elevation of the top of an unmarked hill, add one-half the contour interval to the elevation of the last (highest) contour line around the hill. In our example, the last contour line before the hilltop is an intermediate contour line at an elevation of 440 meters. Add one-half the contour interval, or 10 meters, to the value of this intermediate contour line. The elevation of the hilltop is 450 meters.

There may be times when you must estimate the elevation between contour lines. For example, for a point half-way between contour lines, estimate the elevation to one-half the contour interval. For points less than one-fourth the distance between the lines, use the

same elevation as the nearest line. Remember, if the desired point is on a contour line, its elevation is that of the contour line.

To estimate the elevation to the bottom of a **depression**, subtract one-half the contour interval from the value of the lowest contour line before the depression. In Illustration 2.4.3 (with the contour interval still at 20 meters), the lowest contour line before the depression is 240 meters, which is also the elevation at the edge of the depression. Since 10 meters is one-half the contour interval, the bottom of this depression is 230 meters. The tick marks on the contour line forming a depression always point to lower elevations.



*Illustration 2.4.3*

In addition to contour lines, mapmakers use bench marks and spot elevations to indicate points of known elevation on a map. Bench marks (abbreviated BM) are the more accurate of the two. Mapmakers show a bench mark with a black "X" (such as BMx214) with the center of its elevation given in feet, meters, or yards above sea level. Mapmakers show spot elevations with a brown "X" to mark road junctions, hilltops, or other prominent terrain features.

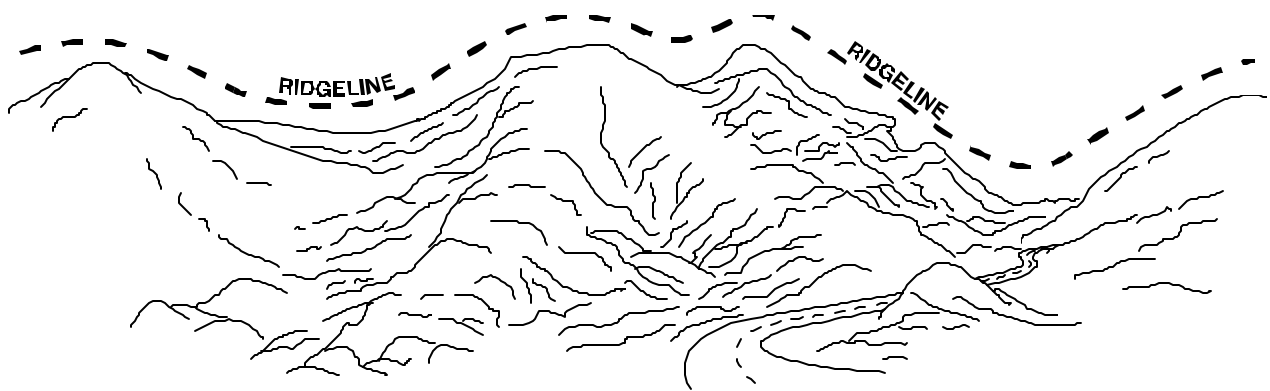
## LANDFORMS

In addition to the map symbols introduced earlier in this unit, mapmakers use symbols to represent natural land formations of the earth's surface. They position them on a map so that the center of the symbol remains in its true location. These symbols closely resemble the actual features when viewed from above.

No matter where you live, there are hills, valleys, streams, or other landforms in

your area. The relief of an area is the illustration of these shapes as depicted on a map. For example, the relief of Denver would be different from that of Salt Lake City.

Most maps depict up to a total of 10 different natural or man-made landforms or terrain features. All terrain features result from landmasses known as mountains or ridgelines. A **ridgeline** is a line of high ground, usually with changes in elevation along its top and low ground on all sides, from which mapmakers classify the 10 terrain features.



*Illustration 2.4.4*

## TERRAIN FEATURES

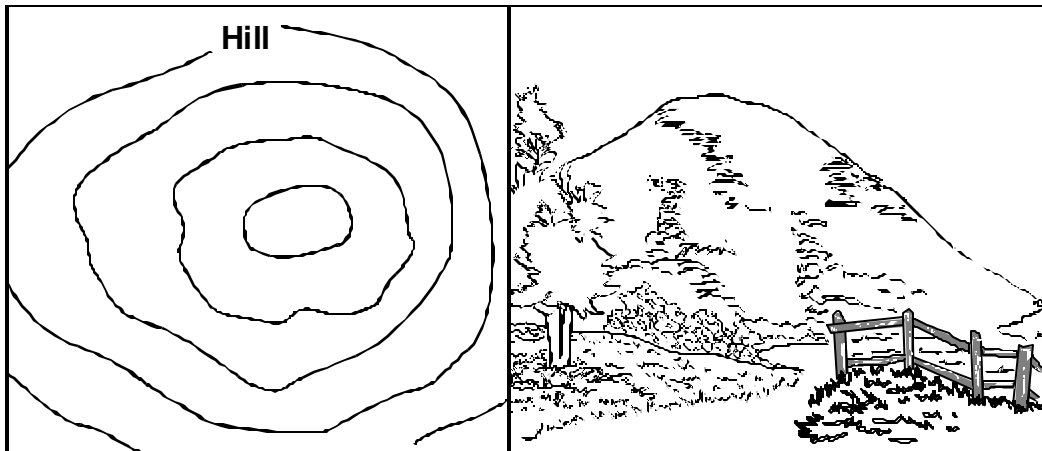
We can divide the 10 natural or man-made terrain features into three categories: major features, minor features, and supplementary features. There are five major features, two minor features, and three supplementary features.

The five major terrain features are:

- hill
- **saddle**
- valley
- **ridge**
- depression

## Hill

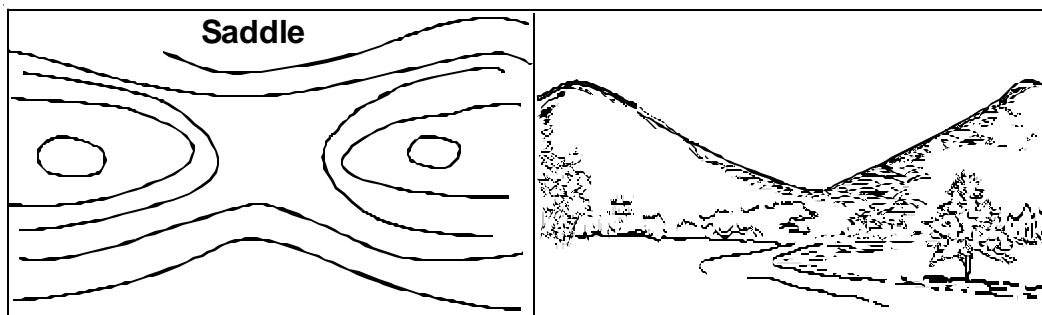
A hill is an area of high ground (see Illustration 2.4.5). When you are located on a hilltop, the ground slopes down in all directions. Maps will show a hill with a regular closed contour line, or a series of **concentric** closed contour lines. The inside of the smallest closed circle is the hilltop. The more contour lines, the higher the hill.

*Illustration 2.4.5*

### *Saddle*

A saddle is a dip or low point between two areas of higher ground (see Illustration 2.4.6). It is not necessarily the lower ground between two hilltops; it may simply be a dip or

break along a level ridge or crest. If you were in a saddle, there would be high ground in two opposite directions and lower ground in the other two directions. Maps will show a saddle with the contour lines forming an hourglass or a figure-eight-shaped feature.

*Illustration 2.4.6*

### *Valley*

A valley is a stretched-out groove in the land, usually formed by streams or rivers (see Illustration 2.4.7). A valley begins with high ground on three sides, and usually has a course of running water through it, which always flows from higher to lower ground. If you were standing in a valley, there would be high ground in two opposite directions and a gradual

slope in the other two directions. Contour lines forming a valley are either “U-shaped” or “V-shaped.” To determine the direction water is flowing, look at the contour lines. The closed end of the “U” or “V” always points upstream or toward the high ground.

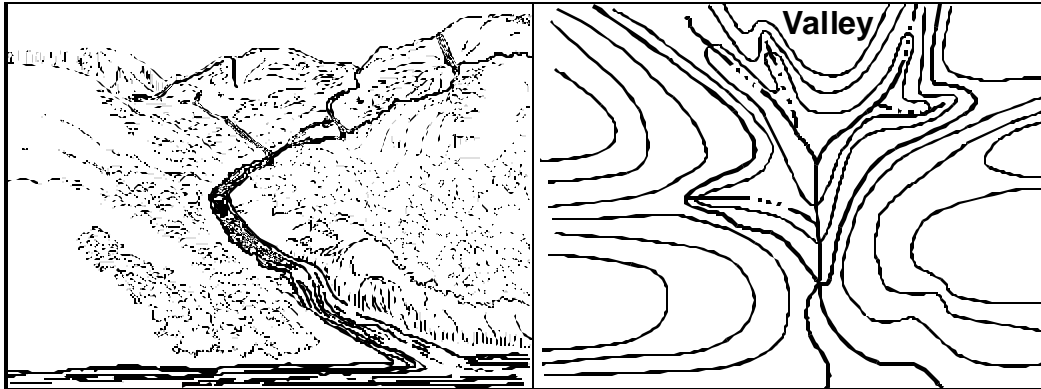


Illustration 2.4.7

### Ridge

A ridge is a sloping line of high ground (see Illustration 2.4.8). If you were standing in the center of a ridge, you would normally have low ground in three directions and high ground in one direction.

If you cross a ridge at right angles, you climb steeply to the crest, and then descend steeply to the base. When you move along the path of the ridge, depending on your location, there may be either a barely noticeable slope or a very obvious incline. Contour lines forming a ridge tend to be “U-shaped” or “V-shaped.” Notice that the closed end of the contour line points away from high ground.

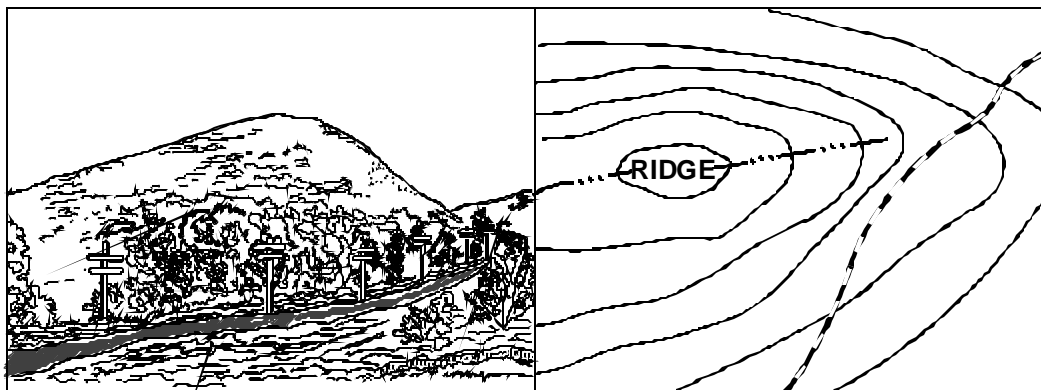
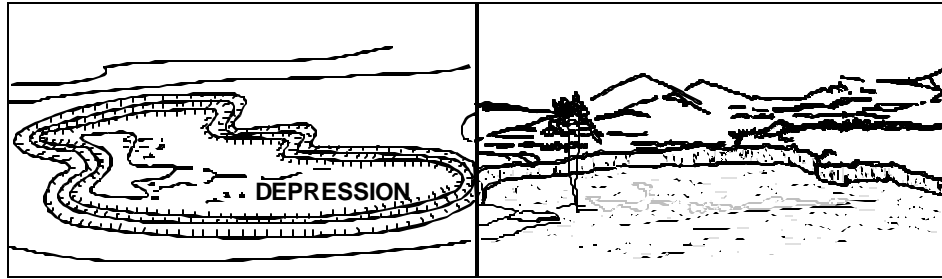


Illustration 2.4.8

### Depression

A depression is a low point in the ground, or a **sinkhole**, surrounded by higher ground in all directions (see Illustration 2.4.9). Maps will show depressions by closed contour

lines that have tick marks pointing toward the low ground. The closer the contour lines, the deeper the depression.



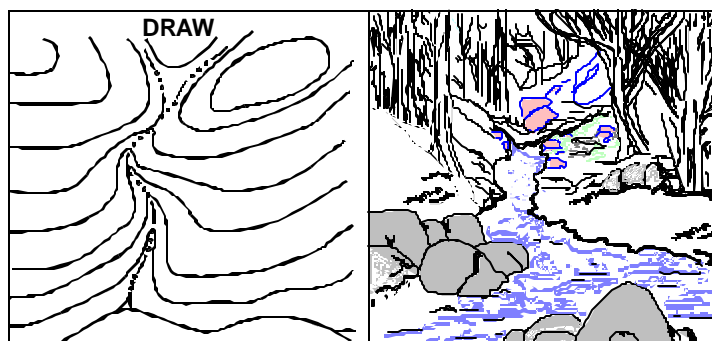
*Illustration 2.4.9*

The two minor terrain features are **draw** and **spur**.

### *Draw*

A draw is a less developed stream course than a valley (see Illustration 2.4.10). There is no level ground. If you were standing in a draw, the ground would slope up in three directions and down in the other. A draw is sometimes considered to be the initial formation of a valley. Maps will show a draw as a series of successive “U-shaped” or “V-shaped” contour lines that point uphill or upstream.

A spur is a short, continuous sloping line of high ground, normally jutting out from the side of a ridge (see Illustration 2.4.11). It is often formed by two parallel streams cutting draws down the side of a ridge. The ground will slope down in three directions and up in one. Maps will show a spur as a series of successive “U-shaped” or “V-shaped” contour lines that point in a downhill direction.



*Illustration 2.4.10*

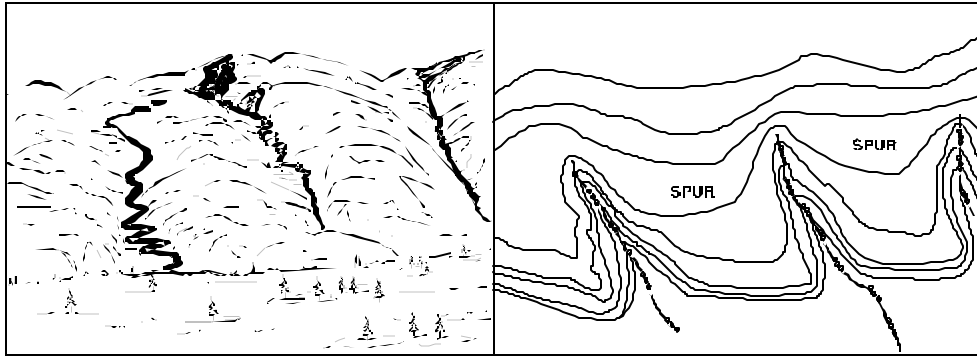


Illustration 2.4.11

In the final category, the three supplementary terrain features are cliff, **cut**, and **fill**.

### Cliff

A cliff is a vertical or near vertical slope that is an abrupt change of the land formation (see Illustration 2.4.12). Maps show the contour

lines for cliffs as being very close together, and in some cases, touching each other.

**Note:** Although, as a general rule, a regular contour line is never broken, there are two exceptions when illustrating a cliff or a very steep slope. A contour line may be broken or may converge. Also, a contour line may be broken for the purpose of printing the elevation number.

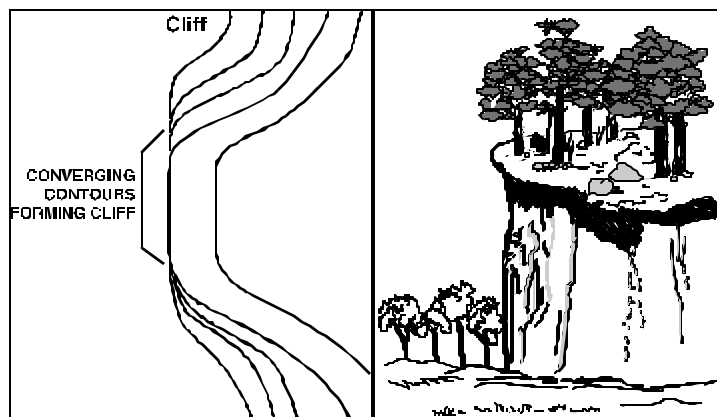


Illustration 2.4.12

### Cut and Fill

Cuts and fills are man-made features resulting from the cutting through of high areas and the filling in of low areas to form a level bed for a road or railroad track (see Illustration 2.4.13). Maps will show cuts when they are at least 10 feet high. Mapmakers draw the contour lines along the length of the cut. They also use tick marks to extend from the cut line to the

roadbed, if the map scale permits this level of detail.

As with cuts, maps will show fills when they are at least 10 feet high. Mapmakers draw the contour lines along the fill line for the length of the filled area and use tick marks to point toward the lower ground.



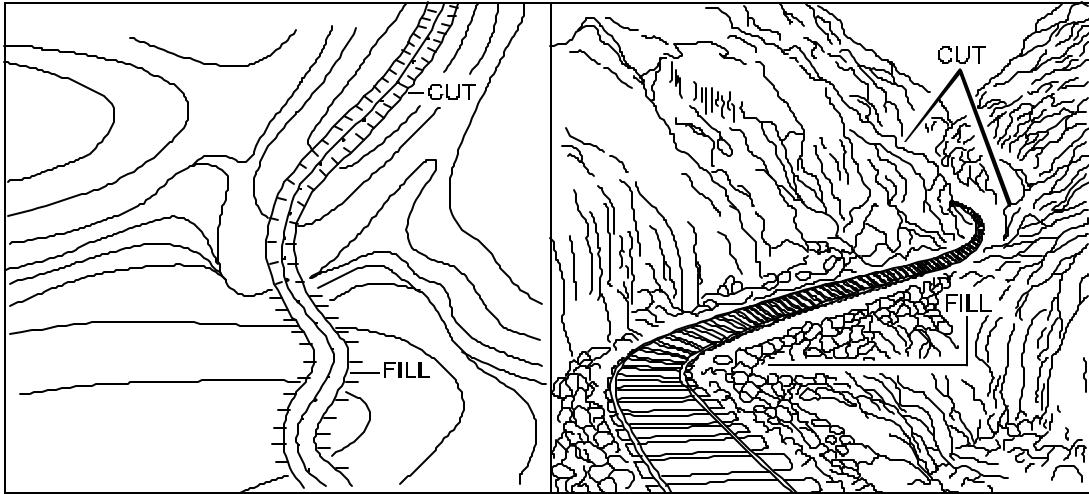


Illustration 2.4.13

Your hand can help you visualize eight of the terrain features mentioned above.

(see Illustration 2.4.14). You can demonstrate all but cuts and fills.

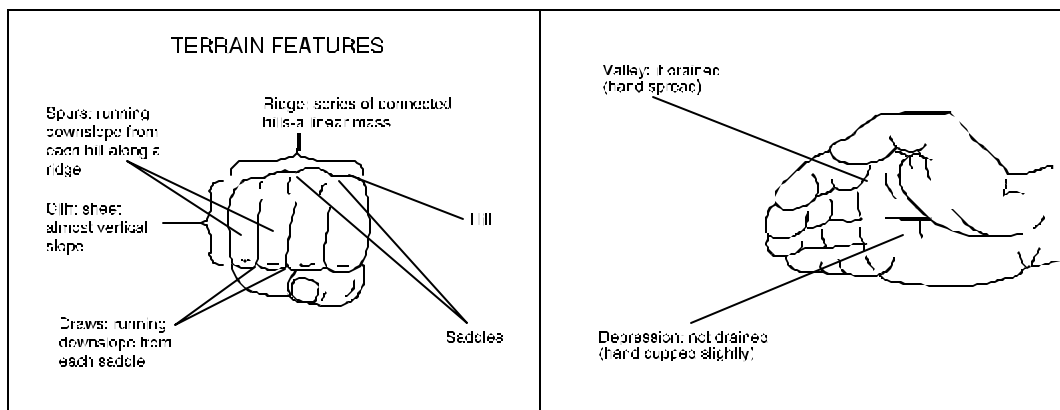


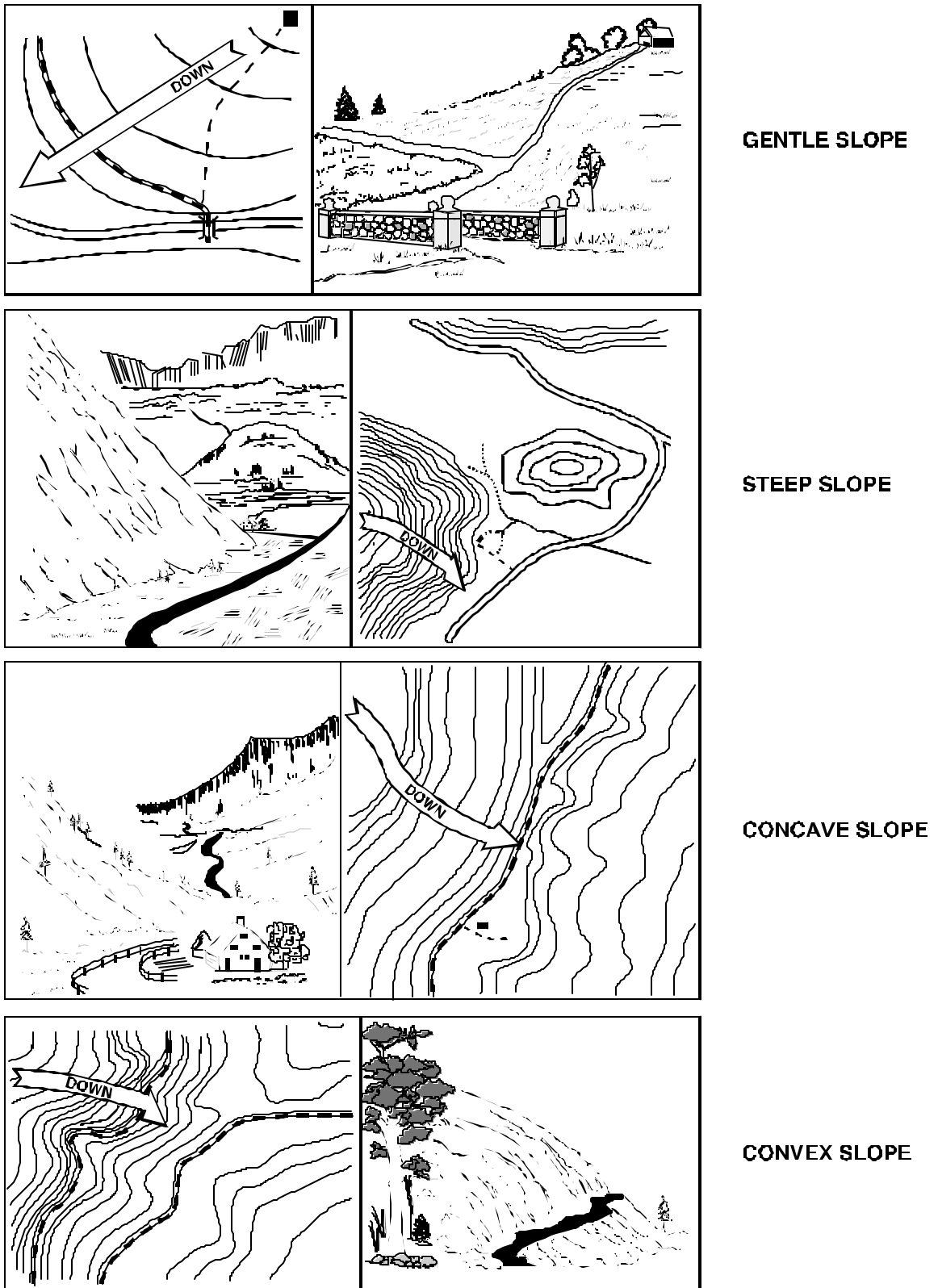
Illustration 2.4.14

### TYPES OF SLOPES

The rate of the rise or fall of the ground is known as its slope. You can determine slope by studying the contour lines on a map — the closer the contour lines, the steeper the slope; the farther apart the contour lines, the gentler the slope. The four types of slopes are gentle, steep, **concave**, and **convex**. Illustration 2.4.15 gives an example of each slope.

Maps show the contour lines for concave slopes as being closely spaced at the top

of the feature and widely spaced at the bottom. Contour lines for convex slopes are just the opposite.

*Illustration 2.4.15*

## CONCLUSION

In this lesson we presented two fundamental concepts of land navigation: understanding elevation and relief and recognizing terrain features.

Practice using these concepts. Study the contours and landforms within your region.

When traveling, look for differences in terrain and elevation. Become successful in applying your map-reading skills so that you will always be able to answer the question, “*Where am I?*”

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